



ENVIRONMENTAL PROTECTION AGENCY

[EPA-HQ-OAR-2015-0093-; FRL-9926-80-OAR]

Notice of Opportunity to Comment on an Analysis of the Greenhouse Gas Emissions Attributable to Production and Transport of *Brassica Carinata* Oil for Use in Biofuel Production

AGENCY: Environmental Protection Agency.

ACTION: Notice.

SUMMARY: In this Notice, the Environmental Protection Agency (EPA) is inviting comment on its analysis of the greenhouse gas (GHG) emissions attributable to the production and transport of *Brassica carinata* (carinata) oil feedstock for use in making biofuels such as biodiesel, renewable diesel, and jet fuel. This notice explains EPA's analysis of the production and transport components of the lifecycle GHG emissions of biofuel made from carinata oil, and describes how EPA may apply this analysis in the future to determine whether biofuels produced from carinata oil meet the necessary GHG reductions required for qualification as renewable fuel under the Renewable Fuel Standard program. Based on this analysis, we anticipate that biofuels produced from carinata oil could qualify as advanced biofuel if typical fuel production process technology conditions are used.

DATES: Comments must be received on or before **[INSERT DATE 30 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]**.

ADDRESSES: Submit your comments, identified by Docket ID No. **EPA-HQ-OAR-2015-0093**, by one of the following methods:

- <http://www.regulations.gov>. Follow the on-line instructions for submitting comments.
- Email: a-and-r-docket@epa.gov, Attention Air and Radiation Docket ID No. EPA-HQ-OAR-2015-0093.
- Mail: **Air and Radiation Docket**, Docket No. EPA-HQ-OAR-2015-0093,
Environmental Protection Agency, Mail code: 28221T, 1200 Pennsylvania Ave., N.W.,
Washington, DC 20460.
- Hand Delivery: EPA Docket Center, EPA/DC, EPA WJC West, Room 3334, 1301
Constitution Ave., NW, Washington, DC, 20460, Attention Air and Radiation Docket, ID
No. EPA-HQ-OAR-2015-0093. Such deliveries are only accepted during the Docket's
normal hours of operation, and special arrangements should be made for deliveries of
boxed information.

Instructions: Direct your comments to Docket ID No. EPA-HQ-OAR-XXXX-XXXX. EPA's policy is that all comments received will be included in the public docket without change and may be made available online at www.regulations.gov, including any personal information provided, unless the comment includes information claimed to be Confidential Business Information (CBI) or other information whose disclosure is restricted by statute. Do not submit information that you consider to be CBI or otherwise protected through www.regulations.gov or e-mail. The www.regulations.gov website is an "anonymous access" system, which means EPA will not know your identity or contact information unless you provide it in the body of your

comment. If you send an e-mail comment directly to EPA without going through www.regulations.gov, your e-mail address will be automatically captured and included as part of the comment that is placed in the public docket and made available on the Internet. If you submit an electronic comment, EPA recommends that you include your name and other contact information in the body of your comment and with any disk or CD-ROM you submit. If EPA cannot read your comment due to technical difficulties and cannot contact you for clarification, EPA may not be able to consider your comment. Electronic files should avoid the use of special characters, any form of encryption, and be free of any defects or viruses. For additional information about EPA's public docket visit the EPA Docket Center homepage at <http://www.epa.gov/epahome/dockets.htm>.

Docket: All documents in the docket are listed in the www.regulations.gov index. Although listed in the index, some information is not publicly available, e.g., CBI or other information for which disclosure is restricted by statute. Certain other material, such as copyrighted material, will be publicly available only in hard copy. Publicly available docket materials are available either electronically in www.regulations.gov or in hard copy at the Air and Radiation Docket, EPA/DC, EPA WJC West, Room 3334, 1301 Constitution Ave., NW, Washington, DC. The Public Reading Room is open from 8:30 a.m. to 4:30 p.m., Monday through Friday, excluding legal holidays. The telephone number for the Public Reading Room is (202) 566-1744, and the telephone number for the Air and Radiation Docket is (202) 566-1742.

FOR FURTHER INFORMATION CONTACT: Michael Shell, Office of Transportation and Air Quality, Mail Code: 6401A, U.S. Environmental Protection Agency, 1200 Pennsylvania

Avenue, NW, 20460; telephone number: 202-564-8479; fax number: 202-564-1177; email address: shell.michael@epa.gov.

SUPPLEMENTARY INFORMATION:

This notice is organized as follows:

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I. Introduction

As part of changes to the Renewable Fuel Standard (RFS) program regulations published on March 26, 2010¹ (the “March 2010 rule”), EPA specified the types of renewable fuels eligible to participate in the RFS program through approved fuel pathways. Table 1 to 40 CFR 80.1426 of the RFS regulations lists three critical components of an approved fuel pathway: (1) fuel type; (2) feedstock; and (3) production process. Fuel produced pursuant to each specific combination of the three components, or fuel pathway, is designated in the Table as eligible for purposes of the Clean Air Act’s (CAA) requirements for greenhouse gas (GHG) reductions to qualify as renewable fuel or one of three subsets of renewable fuel (biomass-based diesel, cellulosic

¹ See 75 FR 14670.

biofuel, or advanced biofuel). EPA may also independently approve additional fuel pathways not currently listed in Table 1 to 40 CFR 80.1426 for participation in the RFS program, or a third-party may petition for EPA to evaluate a new fuel pathway in accordance with 40 CFR 80.1416.

EPA's lifecycle analyses are used to assess the overall GHG impacts of a fuel throughout each stage of its production and use. The results of these analyses, considering uncertainty and the weight of available evidence, are used to determine whether a fuel meets the necessary GHG reductions required under the CAA for it to be considered renewable fuel or one of three subsets of renewable fuel. Lifecycle analysis includes an assessment of emissions related to the full fuel lifecycle, including feedstock production, feedstock transportation, fuel production, fuel transportation and distribution, and tailpipe emissions. Per the CAA definition of lifecycle GHG emissions, EPA's lifecycle analyses also include an assessment of significant indirect emissions such as indirect emissions from land use changes, agricultural sector impacts, and production of co-products from biofuel production.

Pursuant to 40 CFR 80.1416, EPA received a petition from Agrisoma Biosciences Inc. requesting that EPA evaluate the lifecycle GHG emissions for biofuels produced using *Brassica carinata* (carinata) oil,² and that EPA provide a determination of the renewable fuel categories, if any, for which such biofuels may be eligible. As an initial step in this process, EPA has conducted an evaluation of the GHG emissions associated with the production and transport of carinata when it is used as a biofuel feedstock, and is seeking public comment on the methodology and results of this evaluation.

² For purposes of this notice, the term "carinata" refers to the species *Brassica Carinata*.

EPA expects to consider comments received and then use the information to evaluate petitions received pursuant to 40 CFR 80.1416 that propose to use carinata oil as a feedstock for the production of biofuel, and that seek an EPA determination regarding whether such biofuels qualify as renewable fuel under the RFS program. In evaluating such petitions, EPA will consider the GHG emissions associated with petitioners' biofuel production processes, as well as emissions associated with the transport and use of the finished biofuel, in addition to the GHG emissions associated with the production and transport of carinata feedstock in determining whether petitioners' proposed biofuel production pathway satisfies CAA renewable fuel lifecycle GHG reduction requirements.

II. Analysis of GHG Emissions Associated with use of Carinata Oil as a Biofuel Feedstock

EPA has evaluated the lifecycle GHG impacts of using carinata oil as a biofuel feedstock, based on information provided in the petition and other data gathered by EPA. For these analyses, we used a similar approach to that used for camelina oil in a rule published on March 5, 2013 (the "March 2013 rule").³ In that rulemaking, EPA determined that several renewable fuel pathways using camelina oil feedstock meet the required 50% lifecycle GHG reduction threshold under the RFS for biomass-based diesel and advanced biofuel because the GHG emissions performance of camelina-based fuels is at least as good as that modeled for fuels made from soybean oil.

³ 78 FR 14190.

EPA believes that new agricultural sector modeling is not needed to evaluate the lifecycle GHG impacts of using carinata oil as a biofuel feedstock for purposes of making GHG reduction threshold determinations for the RFS program. This is in part because of the similarities of carinata oil to soybean oil and camelina oil, and because carinata is not expected to have significant land use change impacts. Instead of performing new agricultural sector modeling, EPA relied upon the soybean oil analysis conducted for the March 2010 rule to assess the relative GHG impacts of growing and transporting carinata oil for use as a biofuel feedstock. We have looked at every component of the agricultural sector GHG emissions from carinata oil production, including land use change, crop inputs, crushing and oil extraction, and feedstock distribution. For each component, we believe that the GHG emissions are less than or comparable to the emissions from the equivalent component of soybean oil production. Based on this analysis (described below), we propose to evaluate the agricultural sector GHG emissions impacts of using carinata oil in responding to petitions received pursuant to 40 CFR 80.1416 by assuming that GHG emissions are similar to those associated with the use of soybean oil for biofuel production. We invite comment on this proposed approach.

A. Feedstock Production

1. Background

Brassica carinata (*carinata*), commonly known as “Ethiopian mustard” or “Ethiopian rapeseed”, is an oilseed crop within the flowering plant family *Brassicaceae* and is native to the Ethiopian highlands.

Carinata oil has high concentrations of erucic acid which make it less suitable for food uses but potentially attractive for biolubricants and polymers, and other industrial applications.⁴⁵ It is not used for food in the United States where more desirable substitutes are readily available, though there is a limited amount of use for dietary purposes in Africa and western and southern Asia.⁶ The vast majority of carinata currently grown in the United States is in limited field trials to evaluate its qualities as a feedstock to produce biofuels. The U.S. Department of Agriculture (USDA) does not track the production or end-uses of carinata but the petitioner believes 95% of current carinata research has been for biofuels with some limited research on enhanced oil recovery applications.⁷ Compared to other oilseeds, carinata seed contains a high oil content (44%) which means a greater portion of the feedstock can be converted to biofuel.⁸ Carinata oil contains longer carbon chains than other oilseeds, making it more suited to be broken down for industrial uses, and long chain fatty acids make it ideal for biodiesel production. When grown, carinata provides multiple benefits as a biofumigant, serving to suppress disease and insects,⁹ while also controlling weeds and other soil-borne pests.¹⁰

⁴ Taylor, DC et al (2010) Brassica carinata- a new molecular farming platform for delivering bio-industrial oil feedstocks: case studies of genetic modifications to improve very long-chain fatty acid and oil content in seeds Biofuels, Bioproducts & Biorefining 4.5: 538-561.

<http://onlinelibrary.wiley.com/doi/10.1002/bbb.231/epdf>.

⁵ Fahd, S. et. al (2010) Energy, Environmental and Economic Assessment of Non-Food Use of Brassica Carinata http://www.societalmetabolism.org/aes2010/Proceeds/DIGITAL%20PROCEEDINGS_files/POSTERS/P_138_Sandra_Fahd.pdf.

⁶ Plant Resources of Tropical Africa (PROTA). PROTA 14: Vegetable Oils Record Display, Brassica Carinata http://database.prota.org/PROTAhtml/Brassica%20carinata_En.htm.

⁷ Agrisoma Biosciences Inc. petition to the EPA, August 2013.

⁸ Earlier strains of Brassica carinata have contained various, lesser oil contents. However, selective breeding and developments through transgenics have produced strains with high oil contents.

Taylor, DC et al (2010) Brassica carinata- a new molecular farming platform for delivering bio-industrial oil feedstocks: case studies of genetic modifications to improve very long-chain fatty acid and oil content in seeds Biofuels, Bioproducts & Biorefining 4.5: 538-561.

<http://onlinelibrary.wiley.com/doi/10.1002/bbb.231/epdf>.

⁹ Warwick (2011) at 49 (citations omitted); see also I.A. Zasada and H. Ferris (2004), Nematode suppression with brassicaceous amendments: application based upon glucosinolate profiles, Soil Biology & Biochemistry 36:1017–1024.

¹⁰ J. Brown and M.J. Morra, Glucosinolate-Containing Seed Meal as a Soil Amendment to Control Plant Pests. 2000-2002, National Renewable Energy Laboratory, NREL/SR-510-35254, at 15 (2005), available at

2. Volume Potential

Carinata will most likely be grown in the U.S. and Canada in semi-arid, marginal land, as an off-season winter cover crop in the southeastern U.S., or on dryland wheat acres during the period that they would otherwise be left fallow. In areas with lower precipitation, dryland wheat farmers currently leave acres fallow once every three to four years to allow additional moisture and nutrients to accumulate and control pests. Current research indicates that carinata could be introduced into this rotation in certain areas in lieu of fallowing without adversely impacting moisture or nutrient accumulation. Land featuring a carinata rotation can be returned to wheat cultivation the following year with moisture and soil nutrients quantitatively similar to a fallow year.¹¹ Table V.D.-2 illustrates example wheat and carinata rotations, which are expected to be very similar to current wheat/camelina rotation systems.

Table V.D.—2— Examples of Traditional Wheat and Wheat/Carinata Rotations

Example 1: Traditional Winter Wheat/Spring Wheat/Fallow Rotation

	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Year 0										Winter Wheat Planting		
Year 1								Winter Wheat Harvest				
Year 2				Spring Wheat Planting				Spring Wheat Harvest				

<http://www.nrel.gov/docs/fy05osti/35254.pdf>; L. Furlan, C. Bonetto, A. Finotto, L. Lazzeri, L. Malaguti, G. Patalano, W. Parker (2010), The Efficacy of Biofumigant Meals and Plants to Control Wireworm Populations, *Industrial Crops and Products* 31: 245–254.

¹¹ See Shonnard et al., 2010; Lafferty et al., 2009 Long-Term Tillage and Cropping Sequence Effects on Dryland Residue and Soil Carbon Fractions.

Year 3										Winter Wheat Planting		
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Example 2: Winter Wheat/Carinata/Spring Wheat Rotation

	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Year 0										Winter Wheat Planting		
Year 1								Winter Wheat Harvest				
Year 2				Carinata Planting				Carinata Harvest				
Year 3				Spring Wheat Planting				Spring Wheat Harvest		Winter Wheat Planting		



Shaded cells indicate fallow months



Hatched line cells indicate growing months

As we expect that carinata will primarily be grown in rotation with wheat, we based land availability and projected volumes on estimated wheat acres. USDA does not systematically collect carinata production information; therefore data on historical acreage is limited. The latest USDA estimates (December 2014) report approximately 57 million acres of wheat in the U.S.¹² USDA and wheat state cooperative extension reports through 2008 indicated that 83% of domestic wheat production was under non-irrigated, dryland conditions, and that at least 45% of those acres were estimated to follow a wheat/fallow rotation. Thus, approximately 21 million acres are potentially suitable for carinata production. However, according to an industry

¹² U.S. Wheat Supply and Use. World Agricultural Supply and Demand Estimate (WASDE), December 2014. USDA
<http://usda.mannlib.cornell.edu/usda/current/wasde/wasde-12-10-2014.pdf>.

projection¹³ based on an estimate for camelina, only about nine million of these wheat/fallow acres have the appropriate climate, soil profile, and market access for carinata production.¹⁴ Further, the petitioner projects another three million acres of fallow land in wheat rotation are potentially available for carinata production in Canada. Based on our calculations of the potential biodiesel production from carinata, as described below, we do not anticipate demand for carinata oil to be greater than can be satisfied by available fallow acres.

According to an industry estimate, commercial production of carinata in 2012 occurred at over 40 locations across Saskatchewan and Alberta, Canada.¹⁵ The first commercial cultivation of carinata in the United States occurred in Montana in 2013, and estimates from the original petition indicated that 100,000 acres would be planted in 2014.¹⁶ Based on a three year rotation cycle in which only one third of the 12 million combined U.S. and Canada wheat acres is typically fallow in any given year, EPA estimates that at current average yields (1,865 pounds of seed per acre, or 820 pounds of oil per acre), approximately 400 million gallons (MG) of carinata-based biodiesel could be produced with carinata grown in rotation with existing crop acres (assuming 7.6 pounds of oil produces 1 gallon of biodiesel).¹⁷ However, as there is no commercial market for carinata at present, when planted, actual acres are expected to be much smaller and dedicated to test plots in the near term. Carinata may expand to other regions and growing methods in the longer term.

¹³ Agrisoma Biosciences Inc., petition to EPA, August 2013.

¹⁴ Johnson, S. and McCormick, M., Camelina: an Annual Cover Crop Under 40 CFR Part 80 Subpart M, Memorandum, dated November 5, 2010.

¹⁵ In the United States, field trials have occurred or are occurring with the University of Florida, Colorado State University, Montana State University, South Dakota University, and North Dakota State University.

¹⁶ Agrisoma Biosciences Inc. Petition to EPA, August 2013.

¹⁷ For biodiesel produced from soybean oil, 7.6 pounds of oil are also needed for one gallon of biodiesel.

Research is ongoing to improve carinata oil yields, which can be expected to increase as experience with growing carinata improves cultivation practices and the application of existing technologies are more widely adopted. For example, yields of over 1,600 pounds of oil per acre have been achieved on test plots. For the purposes of this lifecycle GHG analysis, EPA is assuming the intermediate current yield of 820 pounds of oil per acre and a biofuel production volume of 400 MG of carinata as representing a reasonable projection of production in 2022.

3. Indirect Impacts

Unlike commodity crops that are tracked by USDA, carinata does not have a well-established, internationally traded market that would be significantly affected by an increase in carinata-based biofuels. Based on the information provided in the petition, returns on carinata are approximately \$107 per acre, given average yields of approximately 1,865 pounds per acre and the current contract price of \$0.14 per pound (See Table 2). For comparison purposes, the USDA estimates of corn and soybean returns, including operating costs but not overhead costs such as hired labor, were between \$206 and \$440 per acre in 2013.¹⁸ Over time, advancements in seed technology, improvements in planting and harvesting techniques, and changes in input usage could significantly increase future carinata yields and returns, but it is unlikely the returns to farmers from carinata will ever compete with the returns from corn, soybeans or other widely traded commodity crops. In addition, because carinata is expected to be grown on fallow land, it will not impact other commodities through land competition. For these reasons, EPA has

¹⁸ USDA Economic Research Service, Commodity Costs and Returns. Available at: <http://www.ers.usda.gov/data-products/commodity-costs-and-returns.aspx>.

determined that, unlike a crop such as soybean, production of carinata-based biofuels is not expected to have a significant impact on other agricultural commodity markets and consequently would not result in significant indirect impacts including indirect land use changes.

Table 2—Carinata Costs and Returns, per acre¹⁹

		2022 Carinata
Inputs	Rates	
Herbicides		
Glysophate (Fall)	16 oz. (\$0.39/oz)	\$7.00
Glysophate (Spring)	16 oz. (\$0.39/oz)	\$7.00
Post	12 oz (\$0.67/oz)	\$8.00
Seed		
Carinata seed	\$.44/lb	\$7.20 (5 lbs/acre)
Fertilizer		
Nitrogen Fertilizer	\$1/lb	\$60.00 (60 lb/acre)
Phosphate Fertilizer	\$1/lb	\$30.00 (30 lb/acre)
Sub-Total		\$ 119.20
Logistics		
Planting Trip		\$10.00
Harvest & Hauling		\$25.00
Total Cost		\$154.20
Yields	lbs/ac	1865
Price	\$/lb	\$0.14
Total Revenue		\$261.10
Returns		\$106.90

Although we expect most carinata used as a renewable fuel feedstock for the RFS program would be grown in the U.S. and Canada, we expect that carinata grown in other

¹⁹ Nitrogen and Phosphate inputs here are based on application rates from test plots. Different combinations of the range of fertilizer inputs we considered may results in higher or lower estimates. Data provided by Agrisoma Biosciences Inc. petition to EPA, August 2013.

countries would also not have a significant impact on other agricultural commodity markets and would therefore not result in significant indirect GHG emissions.

4. Crop Inputs

As part of our analysis of the GHG impacts from growing carinata, we compared crop inputs for carinata to those for soybeans. Inputs compared include nitrogen fertilizer, phosphorus fertilizer, herbicide, diesel, and gasoline.²⁰ We also looked at the nitrous oxide (N₂O) emissions from both the nitrogen fertilizer inputs and the crop residues associated with carinata.²¹

Current literature suggests a range of fertilizer inputs are considered appropriate for growing carinata. The petitioner provided guidance of 60 lbs per acre of nitrogen fertilizer and 30 lbs per acre of phosphorus fertilizer based on application rates for test plots featuring continuous cropping systems, which require more intensive fertilizing.²² We expect that carinata will be grown in fallow rotation with other crops, which will require lesser fertilizer amounts, comparable to those for camelina.²³ Those amounts for camelina are 40 lbs per acre of nitrogen fertilizer and 15 lbs per acre of phosphorous fertilizer.²⁴ Other research has shown higher carinata growth rates with higher rates of nitrogen applications, but there is not consensus on an optimal rate. Therefore, as a conservative estimate we provide a high-end estimate of 80 lbs per

²⁰ Diesel and gasoline used for planting and harvesting. These values assume that no irrigation is needed.

²¹ The IPCC equations for N₂O emissions were updated since our earlier analysis of soybeans. We use the updated equations for our calculations.

²² Petition from Agrisoma Biosciences Inc. to EPA, August 2013.

²³ Cover crops, such as carinata and camelina, require less fertilizer input in a fallow rotation than they might if they were in a dedicated system as there is residual soil nutrients from the primary crop.

²⁴ 78 FR 14190. Regulation of Fuels and Fuel Additives: Identification of Additional Qualifying Renewable Fuel Pathways Under the Renewable Fuel Standard Program, available at: <http://www.gpo.gov/fdsys/pkg/FR-2013-03-05/pdf/2013-04929.pdf>.

acre of nitrogen fertilizer. Further, the petitioner did not recommend potassium fertilizer for carinata production as they assume that the land carinata would be grown on has high potassium levels that would not require augmentation. As a conservative estimate, we assume potassium application rates assumed for camelina as a high input (10 lbs per acre). Given the range of estimates, Table 3 shows a range of input assumptions for carinata production, compared to the Forest and Agricultural Sector Optimization Model (FASOM) agricultural input assumptions for soybeans, which were used in our assessment of soybeans for the March 2010 rule. From the March 2010 rule, we used soybean projected yields for 2022 of 1,500 to 3,000 lbs of seed per acre. For carinata, we used projected 2022 yields of 1,865 lbs of seed per acre.²⁵

Carinata has a higher percentage of oil per pound of seed than soybeans. Soybeans are approximately 18% oil by mass, therefore crushing one pound of soybeans yields 0.18 pounds of oil. In comparison, carinata seeds can contain up to 44% oil.²⁶ The difference in oil yield was taken into account when calculating the emissions per ton of feedstock oil included in Table 3. As shown in Table 3, lifecycle GHG emissions from feedstock production for carinata and soybeans are relatively similar when factoring in variations in oil yields per acre and fertilizer, herbicide, pesticide, and petroleum use.²⁷

²⁵ Average yield from a series of research plots explored by the petitioner. Other studies show a range of yields with various nitrogen and seed spacing applications. One such study showed a yield from ranging from 552 to 2434 lbs of seed/acre. We believe an assumed yield of 1,865 lbs of seed per acre is appropriate.

Pan, X. et al (2012) The effect of cultivar, seeding rate and applied nitrogen on Brassica carinata seed yield and quality in contrasting environments. Canadian Journal of Plant Science. 92: 961-971, available at: <http://pubs.aic.ca/doi/pdf/10.4141/cjps2011-169>.

²⁶ Getinet, A. et al (1996) Agronomic performance and seed quality of Ethiopian mustard in Saskatchewan. Canadian Journal of Plant Science. 76. 387-392, available at: <http://pubs.aic.ca/doi/pdf/10.4141/cjps96-069>

²⁷ For more details on the greenhouse gas emissions associated with agricultural inputs, see “Carinata data and calculations – for docket” on Docket EPA-HQ-OAR-2015-0093.

Table 3—Inputs for Carinata and Soybean Production for Projected 2022 Yields²⁸

	Carinata				Soybeans (varies by region)			
	Inputs (per acre)	Emissions (per ton carinata oil)			Inputs (per acre)	Emissions (per ton soybean oil)		
N2O	N/A	584	-	869 kg CO ₂ eq	N/A	449.0	-	661.1 kg CO ₂ eq
Nitrogen Fertilizer	40 - 80 lbs	160	-	321 kg CO ₂ eq	3.5 - 8.2 lbs	23.2	-	79.1 kg CO ₂ eq
Phosphorus Fertilizer	15 - 30 lbs	21	-	41 kg CO ₂ eq	5.4 - 21.4 lbs	13.5	-	64.8 kg CO ₂ eq
Potassium Fertilizer	0 - 10 lbs	0	-	9 kg CO ₂ eq	3.1 - 24.3 lbs	5.3	-	48.5 kg CO ₂ eq
Herbicide	2.75 - 2.75 lbs	79	-	79 kg CO ₂ eq	0.0 - 1.3 lbs	2.4	-	69.6 kg CO ₂ eq
Pesticide	0 - 0 lbs	0	-	0 kg CO ₂ eq	0.1 - 0.8 lbs	12.4	-	50.2 kg CO ₂ eq
Diesel	3.5 - 3.5 gal	107	-	107.1 kg CO ₂ eq	3.8 - 8.9 gal	227.9	-	622.3 kg CO ₂ eq
Gasoline	0 - 0 gal	0	-	0 kg CO ₂ eq	1.6 - 3.0 gal	93	-	151.4 kg CO ₂ eq
Total		950	-	1426 kg CO ₂ eq		961	-	1443 kg CO ₂ eq

5. Potential Invasiveness

Carinata is not listed on the Federal noxious weed list.²⁹ In a USDA document listing state noxious-weed seed requirements, twenty states include restrictions for unspecified species of the *Brassica* genus, indicating limitations on the use of the plant. Although other species of Brassica are specified in some states, the carinata species is not explicitly identified.³⁰ Regarding invasiveness, an evaluation of carinata in Canada by the Roundtable on Sustainable Biofuels concluded that invasiveness potential is deemed to be low and not difficult to remedy, if remedy is needed.³¹ A weed risk assessment by USDA found that carinata poses a moderate weed risk

²⁸ Based on communication with USDA, sulfur can also be a beneficial fertilizer component for oilseeds such as carinata and soybeans, dependent on local soil characteristics, at application rates of up to 10-20 lbs/acre. There are multiple options for sulfur application as part of a liquid or dry granular mixture that also contain phosphorous and nitrogen. The emissions for fertilizer rates provided in Table 3 capture the likely range of impacts associated with the variety of application options, including ones containing sulfur.

²⁹ USDA, Federal Noxious Weed List, http://www.aphis.usda.gov/plant_health/plant_pest_info/weeds/downloads/weedlist.pdf.

³⁰ USDA, Agricultural Marketing Service State Noxious-Weed Seed Requirements Recognized in the Administration of the Federal Seed Act, 2014, <http://www.ams.usda.gov/AMSV1.0/getfile?dDocName=STELPRDC5090172>.

³¹ SCS Global Services, Certification Evaluation Report, Roundtable on Sustainable Biomass, http://rsb.org/pdfs/reports/RSB_PGF-Biofuel_SummaryRPT_InitialEvaluation111513.pdf.

potential and concluded that *carinata* should undergo further evaluation.³² Unlike some other biofuel feedstocks evaluated under the RFS program for invasiveness, USDA did not find strong evidence of *carinata* causing impacts in anthropogenic (e.g., cities, suburbs, roadways), production (e.g., agriculture, nurseries, forest plantations, orchards), or natural systems. However, there is a high level of uncertainty regarding *carinata*'s spread and impact potential due to incomplete knowledge about its traits. This uncertainty raises concerns about the threat of invasiveness and may require remediation activities that would cause additional GHG emissions. Because *carinata* does not pose as great an invasiveness risk as *Arundo donax* and *Pennisetum purpureum*, EPA believes that monitoring and reporting requirements similar to those for *Arundo donax* and *Pennisetum purpureum* would be appropriate, but does not expect to apply all of the Risk Management Plan (RMP) requirements that exist for those feedstocks. We would expect to impose monitoring and reporting requirements similar to 40 CFR 80.1450 (b)(1)(x)(A)(I)(i), (ii), (iii), and (v) and 80.1450 (b)(1)(x)(A)(3), (4), (5), and (7). In addition, a letter documenting the feedstock grower's compliance with all of the relevant federal, state, regional, and local requirements related to invasive species would be required. With these requirements in place, we would assume that there are no GHG emissions associated with potential invasiveness when *carinata* is used as a biofuel feedstock. EPA is taking comment on the invasiveness concerns of *carinata* and the appropriateness of the referenced requirements in mitigating those concerns.

6. Crushing and Oil Extraction

³² USDA, Weed Risk Assessment for *Brassica carinata* A. Braun (Brassicaceae) –Ethiopian mustard, 2014.

EPA evaluated the seed crushing and oil extraction process and compared the lifecycle GHG emissions from this stage for soybean oil and carinata oil. EPA assumed the processing of carinata would be similar to soybeans, canola, and camelina. Because carinata seeds produce more oil per pound than soybeans, the lifecycle GHG emissions associated with crushing and oil extraction are lower for carinata than soybeans per pound of feedstock oil produced.

There is not a significant amount of industry data on energy used for crushing and oil extraction of carinata. Based on data provided in the petition submitted, and EPA's standard emissions factors for electricity and natural gas, we estimate that the GHG emissions from crushing and oil extraction are 92 kgCO₂e/ton carinata oil. For comparison, in the analysis for the March 2010 final rule, the GHG emissions from crushing and oil extraction were estimated to be 426 kgCO₂e/ton soybean oil. As a conservative estimate, we propose to assume that the GHG emissions related to crushing and oil extraction are the same for carinata as for soybeans.

Similar to soybeans, a press cake is also produced when carinata is crushed and the oil is extracted. Little is known at this time about the possible beneficial use of carinata cake. Carinata press cake contains glucosinolates, which may be toxic to animals in large concentrations.³³ However, the heat produced from crushing carinata seeds may reduce the toxicity of the press cake, or carinata press cake could be mixed in low amounts with other seed meal for use as animal feed.³⁴ Alternatively, carinata press cake could be used as a

³³ USDA, Weed Risk Assessment for Brassica carinata A. Braun (Brassicaceae) –Ethiopian mustard. 2014

³⁴ Carinata meal (solvent extracted) is approved for feed use at quantities up to 10% of total diet dry matter in Canada by the Canadian Food Inspection Agency (CFIA).

Letter from W. Gwayumba, PhD sent to EPA in email from Sandra Franco on July 9, 2014.

The Brassica genus (not carinata explicitly) is approved by the U.S. Food and Drug Administration (FDA) through a memorandum of understanding (MOU) with the Association of American Feed Control Officials (AAFCO)

biofumigant.³⁵ In our modeling of soybean oil for the March 2010 RFS rule, the FASOM and FAPRI-CARD models included the use of the soy meal (sometimes referred to as press cake) co-product as livestock feed. In our modeling, the use of soy meal as livestock feed displaced the need for other similar feed products and therefore impacted the relative prices and production of crop and livestock products. These crop and livestock impacts were reflected in the land use change, livestock, and agricultural sector GHG emissions impacts estimated for biofuels produced from soybean oil. Although EPA modeling results did not isolate the GHG impacts of the soy meal co-product, we believe that overall the soy meal co-product lowered the GHG emissions associated with soybean oil-based biofuels. Similarly, we believe that any use of the carinata press cake would provide an additional benefit (i.e., lower GHG emissions) not reflected in our lifecycle GHG emissions analysis of carinata oil. Based on our analysis of carinata oil, which does not consider use of the press cake, we have found that the agricultural, livestock, and land use change emissions associated with producing carinata oil are less than or equal to the corresponding emissions associated with producing soybean oil. Therefore, any beneficial use of the carinata press cake (e.g., as livestock feed or boiler fuel) would only serve to lower the GHG emissions associated with carinata oil relative to the corresponding emissions for soybean oil.

U.S. Food and Drug Administration. Memorandum of Understanding Between The U.S. Food and Drug Administration and The Association of American Feed Control Officials (MOU 225-07-7001)
<http://www.fda.gov/AboutFDA/PartnershipsCollaborations/MemorandaofUnderstandingMOUs/DomesticMOUs/ucm115778.htm>.

It is important to note that all animal feed products must be approved by the U.S. Food and Drug Administration (FDA) before they can be sold in the United States. Nothing in EPA's analysis should be construed as an official federal government position regarding the approval or disapproval of carinata press cake as an animal feed. Only FDA is authorized to make that determination.

³⁵ J. Brown and M.J. Morra, Glucosinolate-Containing Seed Meal as a Soil Amendment to Control Plant Pests. 2000-2002, National Renewable Energy Laboratory, NREL/SR-510-35254, at 15 (2005), available at <http://www.nrel.gov/docs/fy05osti/35254.pdf>; L. Furlan, C. Bonetto, A. Finotto, L. Lazzeri, L. Malaguti, G. Patalano, W. Parker (2010), The efficacy of biofumigant meals and plants to control wireworm populations, *Industrial Crops and Products* 31: 245–254.

B. Feedstock Distribution

EPA's assessment, based on the following reasoning, is that GHG emissions from feedstock distribution will be the same for carinata as such emissions for soybeans. Because carinata contains more oil per pound of seed, as discussed above, the energy needed to move the carinata before oil extraction would be lower than soybeans per gallon of oil produced. To the extent that carinata is grown on more disperse fallow land than soybeans and would need to be transported further, the energy needed to move the carinata could be higher than soybeans. Therefore, we believe we may assume for purposes of GHG emissions assessment that the GHG emissions associated with transporting carinata and soybeans to crushing facilities will be the same. Carinata and soybean oils are similar in terms of density and energy content; therefore, we also assumed that the GHG emissions from transporting the oil from a crushing facility to a biofuel production facility would be the same for the two different feedstocks.

C. Summary of Agricultural Sector GHG Emissions

Compared to soybean oil, carinata oil has comparable GHG emissions per ton of oil from crop inputs and crushing and oil extraction, and lower GHG emissions per ton of oil from direct and indirect land use change. Carinata and soybean oils are also likely to have similar GHG emissions from feedstock distribution. Therefore, we believe that the feedstock production and transport portion of the lifecycle GHG emissions associated with carinata are likely to be similar to or less than the GHG emissions for the corresponding portion of the lifecycle analysis for soybean oil. EPA's purpose in evaluating petitions under 40 CFR 80.1416 is not to prepare a

precise lifecycle GHG emissions analysis of every fuel type, but to gather sufficient information on which to inform its decision of whether proposed biofuels qualify under the program in terms of lifecycle GHG emissions reduction. Based on our comparison of carinata oil to soybean oil, EPA proposes to use, in its future evaluations of petitions seeking to use carinata oil as a feedstock for biofuel production, an estimate of the GHG emissions associated with the cultivation and transport of carinata oil that is the same as that which we have used for soybean oil, on a per ton of oil basis. Although EPA could conduct a more detailed analysis, we do not believe it is necessary for purposes of the determinations EPA must make in responding to petitions. EPA solicits comment on this proposed approach.

D. Fuel Production and Distribution

Carinata oil has physical properties that are similar to soybean and camelina oil, and is suitable for the same conversion processes as these feedstocks. In addition, the fuel yield per pound of oil is expected to be the same for each of these feedstocks. After reviewing comments received in response to this Notice, we will combine our evaluation of agricultural sector GHG emissions associated with the use of carinata oil feedstock with our evaluation of the GHG emissions associated with individual producers' production processes and finished fuels to determine whether the proposed pathways satisfy CAA lifecycle GHG emissions reduction requirements for RFS-qualifying renewable fuels. Based on our evaluation of the lifecycle GHG emissions attributable to the production and transport of carinata oil feedstock, EPA anticipates that fuel produced from carinata oil feedstock through the same transesterification or hydrotreating process technologies that EPA evaluated for the March 2010 RFS rule for biofuel

derived from soybean oil and the March 2013 RFS rule for biofuel derived from camelina oil would qualify for biomass-based diesel (D-code 4) RINs or advanced (D-code 5) RINs.³⁶

However, EPA will evaluate petitions for fuel produced from carinata oil feedstock on a case-by-case basis.

III. Summary

EPA invites public comment on its analysis of GHG emissions associated with the production and transport of carinata oil as a feedstock for biofuel production. EPA will consider public comments received when evaluating the lifecycle GHG emissions of biofuel production pathways described in petitions received pursuant to 40 CFR 80.1416 which use carinata oil as a feedstock.

Dated: April 17, 2015.

Christopher Grundler,

Director, Office of Transportation and Air Quality.

(6560-50-P)

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³⁶ The transesterification process that EPA evaluated for the March 2010 RFS rule for biofuel derived from soybean oil feedstock is described in section 2.4.7.3 (Biodiesel) of the Regulatory Impact Analysis for the March 2010 RFS rule (EPA-420-R-10-006). The hydrotreating process that EPA evaluated for the March 2013 rule for biofuel derived from camelina oil feedstock is described in section II.A.3.b of the March 2013 rule (78 FR 14190).